CHAPTER 5
Lessons from the Development of the U.S. Broiler and Catfish Industries: Implications for Offshore Aquaculture in the United States

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This chapter examines the emergence and development of the U.S. broiler and catfish industries. A brief overview of each industry, along with key factors associated with each industry's success, is identified and discussed. Reflecting on the two industries presented, some important lessons emerge that can be applied to the development of a U.S. offshore aquaculture industry. This chapter will explore those lessons and discuss their relevance with regard to the emergence of an offshore aquaculture industry in the U.S.

Brief Case Study of the United States Broiler Industry

Introduction

Before the advent of the broiler industry, chicken meat was strictly a byproduct of the egg industry (USDA/NASS, 2002). Today, the U.S. broiler industry is the world's largest producer and exporter of poultry meat (USDA/NASS, 2005). Some of the key factors attributed to the industry's success include: contract growing, vertical integration, enhancements in nutrition, advances in disease control, and improvements in broiler production, processing, and marketing (Watts and Kennett, 1995). Collectively, these advancements contributed to the growth and development of this industry. Production increased more than ten-fold from 1934-1945; it nearly tripled the following decade; and it more than doubled from 1955-1965 (Figure 5.1). Due to its ability to expand and evolve rapidly, the industry rose from non-existence to one that provided a key staple of the American diet by the latter third of the century. The per-capita consumption of chicken now stands at 81.1 pounds, greater than beef (62.0), pork (48.5), and seafood (16.3) (USDA/ERS, 2004a; NMFS, 2005). Furthermore, the gap between the per-capita consumption of chicken and the per-capita consumption of all red meats (pork, beef, lamb, and veal) has been steadily narrowing (Figure 5.4).

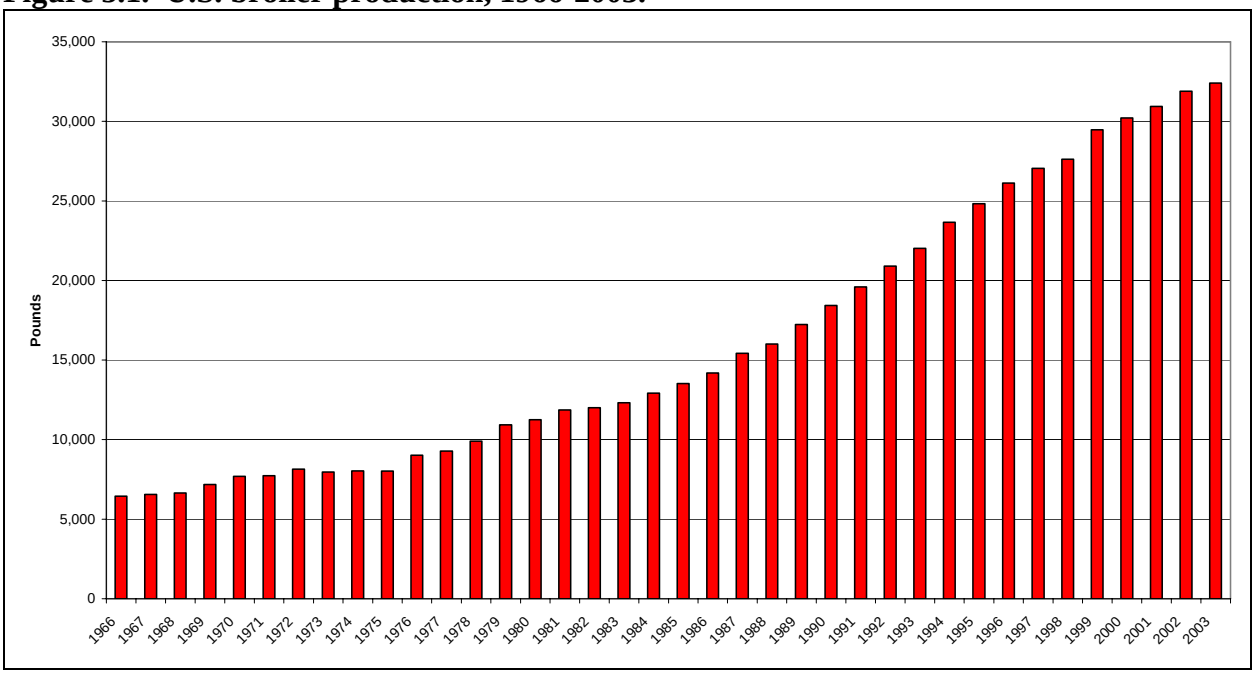
Industry Development

The industry has evolved from millions of small backyard flocks to less than 50 highly specialized, vertically-integrated agribusiness firms (USDA/NASS, 2002). One can see the transition to a highly organized and integrated industry by examining the evolution of the number and capacity of chicken hatcheries. In 1934, 11,405 facilities hatched all of the U.S. chickens; by contrast, in 2001 that number had dropped to 323 hatcheries (USDA/NASS, 2002).

In the early years of the industry, the majority of broilers were bred and produced in New England. Today the majority of this production is centered in the southeastern U.S. around the top five producing states: Georgia, Arkansas, Alabama, Mississippi, and North Carolina. In 2004, the U.S. broiler industry produced 34.1 billion pounds of meat with a retail equivalent value of 43 billion dollars. The United States is the world's largest exporter of broilers. In 2004, broiler exports totaled 4.8 billion pounds (15% of total production), and were valued at $1.7 billion (USDA/ERS, 2005). While the volume of product may seem small relative to total production, the value of broiler exports ($1.7 billion in 2004) is greater than the value of the

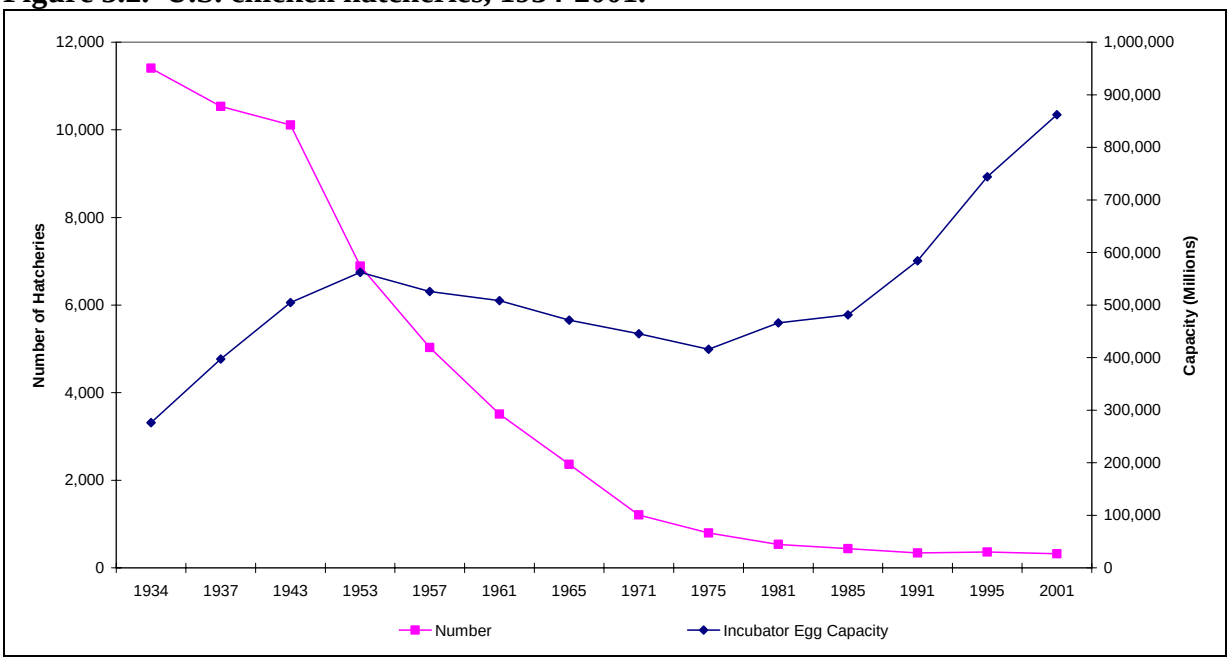
entire U.S. aquaculture industry, which is approximately $1 billion. In contrast, the U.S. imports a very small amount of broiler products, accounting for less than 1% of domestic production (USDA/ERS, 2005).

Figure 5.1. U.S. broiler production, 1966-2003.



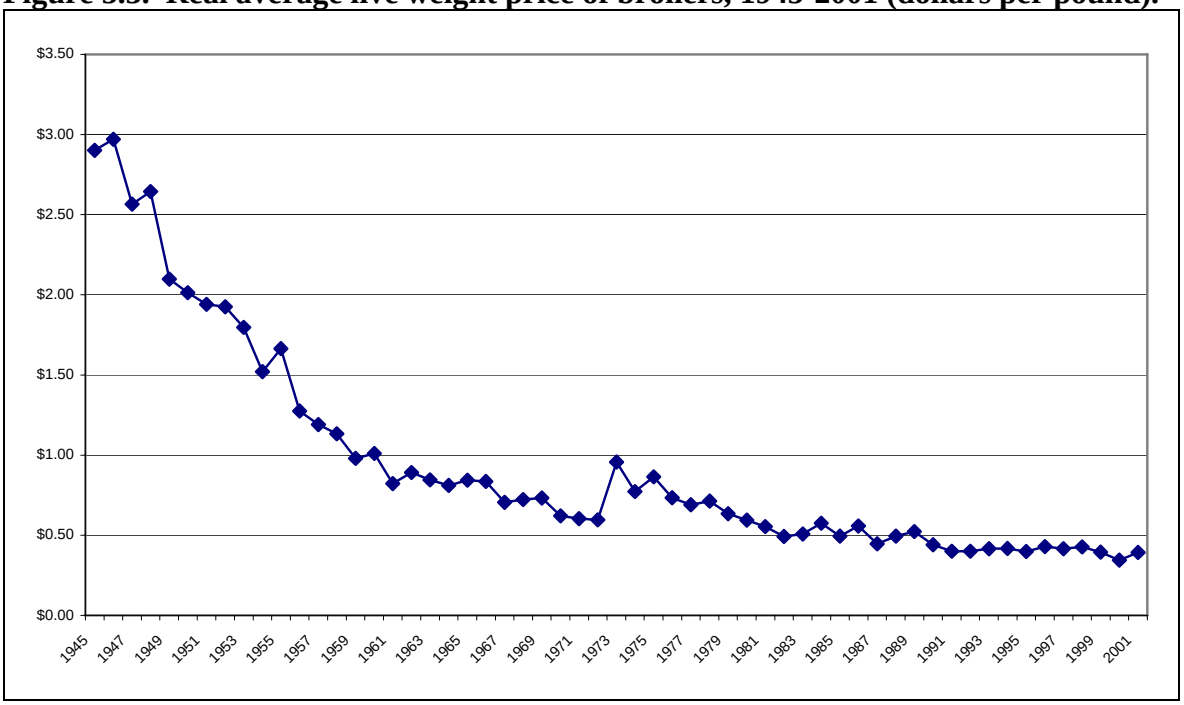
Source: USDA/ERS, 2004

Figure 5.2. U.S. chicken hatcheries, 1934-2001.



Source: USDA/NASS, 2002

Figure 5.3. Real average live weight price of broilers, 1945-2001 (dollars per pound).



Source: USDA/NASS, 2002
Note: *Nominal Prices converted to 2001 dollars by the Bureau of Labor Statistics Consumer Price Index (All Urban Consumers 1982-84=100)

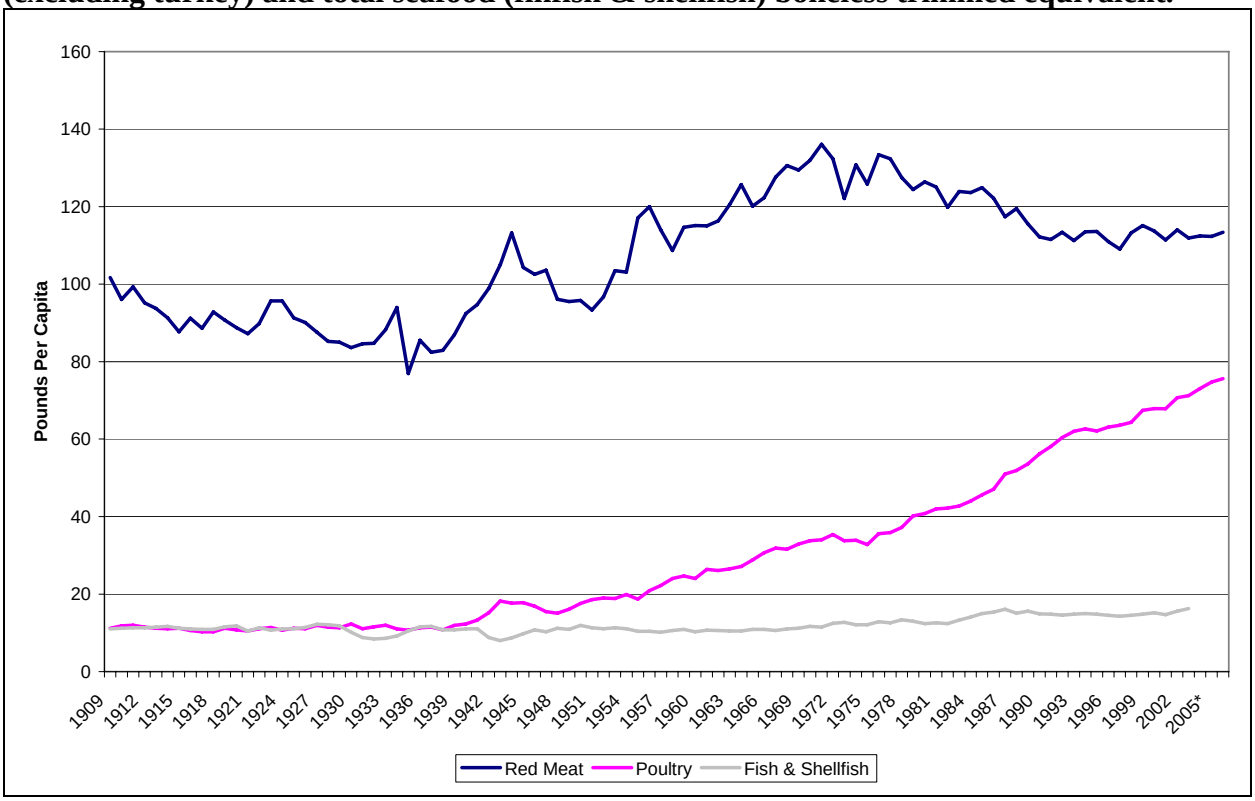
The total farm value of U.S. poultry production in 2003 was $23.3 billion and broiler production accounted for $15.2 billion of that value. While the nominal price per pound has remained essentially constant, the real price of broilers per pound has fallen 85% since 1946. Through its amazing expansion, the broiler industry has been able to catch up with and surpass both per-capita pork consumption in 1986 and per-capita beef consumption in 1993 (USDA/ERS, 2004a). The per-capita consumption of total red meats, which includes beef, pork, veal, and lamb is still greater than the per-capita consumption of total chicken, which includes both young chickens (broilers) and other chicken, although the gap between the two is steadily narrowing (Figure 5.4).

Key Factors in the Industry's Development

Automation

Automation in processing signaled a major development in the industry. During this period, the industry became more capital intensive, as workers were replaced by machines that could process birds more quickly and efficiently. According to the U.S. Department of Labor, Bureau of Labor Statistics, productivity in poultry processing doubled in the 20-year period from 1973 to 1992 (Watts and Kennett, 1995). This increased efficiency in production led to a significant increase in the supply of broilers in the market, which was also a contributing factor in the decline of live weight, price per pound of broilers. The end result of this over-supply was consolidation in the industry, as operating losses mounted for many firms.

Figure 5.4. Per-capita consumption of total red meat (pork, beef, lamb, veal), total chicken (excluding turkey) and total seafood (finfish & shellfish) boneless trimmed equivalent.



Source: USDA/ERS, 2004a; NMFS, 2005

Improved Husbandry Techniques

Improvements in husbandry techniques also led to industry expansion. Broiler growth rates improved as vitamins, antibiotics, high-energy diets, and the inclusion of different amino acids became more prevalent. If one were to compare the diet of a broiler in 1912 to the diet of a broiler in 1958, the same three-pound broiler would mature 34 days sooner on the 1958 diet (44 days) as compared to the 1912 diet (78 days) (Watts and Kennett, 1995). Today, that figure has been reduced to less than 42 days for a three-pound broiler (Bell, 2005).

Disease also played a major role in development of the industry. During the 1920s and 1930s, two major diseases hit the broiler industry: pullorum and coccidiosis. Initially, these diseases devastated producers, some of whom experienced broiler mortality rates of 50% (Watts and Kennett, 1995). Over time, both of these diseases were brought under control through the use of antibiotics, enhanced diet formulas, and improved husbandry techniques.

A more recent threat to the industry has been avian influenza (AI), which is classified as either low pathogenic (LPAI) or highly pathogenic (HPAI) depending on the severity of the illnesses they cause (USDA/APHIS, 2001). Birds infected with LPAI may show few or no clinical signs of infection; however, birds infected with HPAI can quickly succumb to this extremely infectious and fatal disease, often without warning. Humans have also been susceptible to certain strains of the HPAI virus. In 1997 in Hong Kong, a strain known as H5N1 infected chickens as well as 18 humans—6 of whom later died. Domestically, a major outbreak

of HPAI occurred in the Northeast United States in 1983-1984 and resulted in the destruction of more than 17 million birds. This disease cost the industry nearly $65 million and caused retail egg prices to increase by more than 30% (USDA/APHIS, 2001). More recently in 2004, an outbreak of HPAI occurred in Texas, while outbreaks of LPAI occurred in Delaware and New Jersey. The rapid spread of HPAI, especially in Asian regions, has stimulated concern for both animal and human health (USDA/APHIS, 2001). Both globally and locally, animal and human health organizations are actively monitoring both domestic flocks and imported birds for the disease in the hopes of minimizing potential outbreaks, especially since most experts agree that another influenza pandemic is "inevitable and possibly imminent" (WHO, 2004).

Vertical Integration

Through the use of contract growing, the broiler industry has reduced costs and improved the quality and value of the final product. The prevalent contractual agreement in the broiler industry can be broken down as follows. Individual companies, also known as "integrators," own and control a large portion of the production process. They typically own the breeder flocks, hatcheries, feed mills, and processing plants, leaving the actual grow-out process to individual farmers. The integrators are responsible for the provision of chicks, feed, medication, and sometimes fuel used in the brooding process. In addition, integrators provide representatives from the company to administer field supervision and technical advice to the farmers. This high level of involvement in the production process helps ensure that farmers consistently provide a high-quality product that meets specific company standards.

On the other side of this agreement is the individual farmer, or producer, as he or she is known, who provides the growing facilities, equipment, labor, fuel and electricity, and day-to-day supervision of the chicks until slaughter. Broiler farms are required to be located within a certain number of miles away (25-35 miles) from key facilities such as feed mills, processing plants, and hatcheries. This restriction helps reduce transportation costs across the various stages of production. When the birds are ready for slaughter, the producers receive a payment corresponding to the pounds produced plus a bonus based upon a performance ranking against other producers. Often, producers are ranked based upon an average production cost per pound for all flocks sold during a given week (Cunningham, 2002). A common arrangement is 3.8 to 4.6 cents per pound of live weight plus 0.01 cents per pound for each 0.01-point advantage (relative to the average) that a grower achieves in production costs (Cunningham, 1999). This sort of arrangement benefits both parties because it helps reduce risk on the producers' side and helps ensure quality and consistency of product on the integrators' side.

As the industry transitioned from whole chickens to de-boned, highly-processed and value-added products, the need for consistency in size and quality heightened. This is especially true in the mechanical processing of the birds, since automated machines cannot easily adjust to various sized birds. Furthermore, consumers demand a consistent, reliable product in the marketplace, and heterogeneity on the production line only hinders the ability of firms to provide a consistent product. A major benefit of the contractual arrangement between processors and producers is the inherent risk sharing across the entire production process. With their roles and expectations clearly defined, farmers and processors are able to devote time and resources toward long-term investments and improvements in their production processes rather than

behaving more myopically. By reducing the amount of risk each faces, more optimal decisions can be made across the entire planning horizon.

Research and Development

A major development in the broiler industry was the "Chicken of Tomorrow" competition. In 1944, Howard C. "Doc" Pierce, national research director for A&P Food Stores, discussed at a Canadian poultry meeting the need for development of a broad-breasted chicken similar to the broad-breasted turkey (Watts and Kennett, 1995). Soon after that meeting, a nationwide competition was established. National finalists were assembled from the winners of 40 state and regional contests during 1946 and 1947. The national final was held in Georgetown, Delaware in 1948. Contestants sent two cases of eggs to the organizers of the national competition so that all of the eggs could be hatched, fed, grown, slaughtered, and processed as "New York Dressed" under identical conditions. USDA officials conducted a thorough inspection of the meat for quality and consistency characteristics, and the winning contestant was presented with a cash prize. The contest was so successful that, in 1951, another competition was held. This competition was critical to development of the industry, because it helped the broiler industry establish itself as an industry of its own. From now on, broilers were no longer considered a mere byproduct of the egg industry, and the so-called dual purpose bird became virtually extinct (USDA/ERS, 2001; Watts and Kennett, 1995).

Industry Collaboration

Industry leaders realized the importance of a common, unified voice and a strong marketing campaign. Created in 1954, the National Chicken Council's (NCC) three principal activities are in the areas of: public affairs, consumer education/public relations, and membership services. According to its website, the NCC's primary purpose is to "represent the interests of the broiler industry in Washington" (NCC, 2005). The industry also collaborated through the NCC to stimulate greater consumer demand. The NCC devotes 40% of its budget "to promote the use of chicken and maintain a positive image of the industry." It sponsors events and contests such as the National Chicken Cooking Contest and it publishes "The Chicken Cookbook," both of which promote chicken consumption.

Future Outlook

Over time, two outlets for the broiler product—the fast food market and export market—emerged. These two channels did not exist in the early years of the industry. Growth in these two channels is expected to remain strong. The development of further processed convenience foods—such as value-added products like boneless breasted meats and thighs, batter-breaded fried parts, patties, and nuggets—continues to open up new markets for the broiler industry.

Domestically, chicken consumption is forecasted to remain strong, especially given the per-capita consumption of broilers over time, relative to other protein sources (Figure 5.4). Furthermore, global demand for chicken products is expected to remain strong, which is encouraging for U.S. producers, given that the U.S. is the world's largest exporter of broilers. The real, live weight price per pound has remained stable for the past 14 years, averaging 40 cents per pound over that period. Provided there are no major disease outbreaks, such as avian influenza, to disrupt the supply of broilers on the market, the average price per pound will most likely remain stable. The U.S. broiler industry does not face any serious foreign competition

from imports, and the industry has done a relatively good job of coordinating production to minimize supply gluts.

Costs will play an important role in the industry; especially if feeds costs, and in particular fish meal prices, rise. Feed costs represented 60% of total production costs for young chicken farm production, measured on a live weight basis in 2002 (USDA/ERS 2004b). Over the past 20 years, feed costs have averaged 63%, fluctuating between a high of 70% in 1984 and a low of 58% in 1999 (USDA/ERS 2004b). Energy costs will also play an important role as the cost of a barrel of oil continues to rise. Despite the potential for shrinking profit margins on the cost side, the outlook for the industry remains strong.

Brief Case Study of the United States Catfish Industry

Introduction

The U.S. catfish industry expanded from a local, specialty species to a product with national appeal by developing strong partnerships with local government and universities and by collaborating as an industry to brand its product. The end result has been an industry that contributes to the local economy and competes with foreign producers. The industry has expanded from a relatively small, wild fishery to the largest sector within the U.S. aquaculture industry. There has been a greater than four-fold increase in production from 62,256 metric tons (mt) in 1983 to 285,967 mt in 2004 (Figure 5.5). This level of production places the U.S. catfish industry third behind the Alaska walleye pollock (1,519,928 mt) and menhaden (679,311 mt) in total U.S. seafood production in 2004.

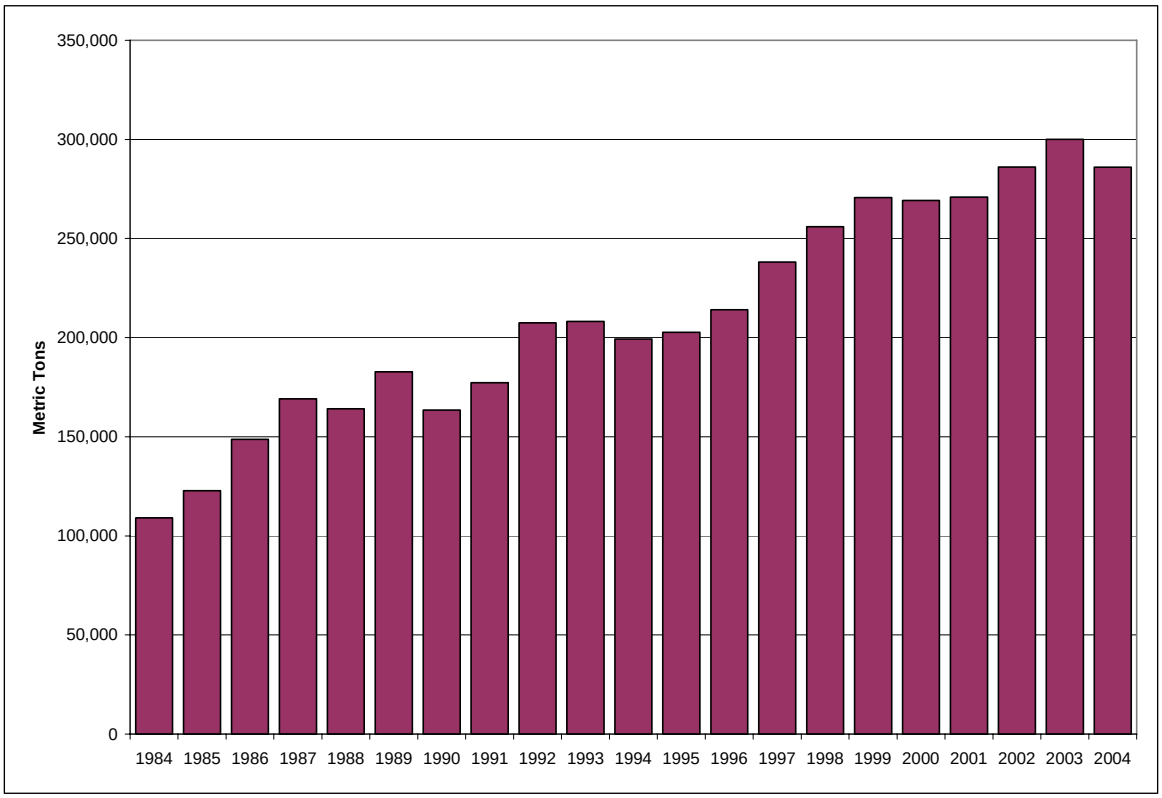
When measured by value, however, the U.S. catfish industry ranks first ($438,845,737) among all species produced (including all wild-capture and farmed species), followed by American lobster ($365,749,516), sea scallops ($320,975,956) and Alaska walleye pollock ($271,424,181). Consumers can now find catfish in almost every major supermarket chain across the country. This broad availability stands in stark contrast to the product's availability 20 years ago, when one would not have seen catfish outside the southeastern United States.

Industry Development

The modern catfish farming industry originated in the Mississippi Delta during the late 1960s and early 1970s. Local farmers desired to diversify their farms, and they sought alternatives to the more prevalent, low-priced row crops grown in clay-based soils (Dean et al., 2003). The near-level land surface and abundant groundwater found in the Delta gave the area a natural advantage in the production of channel catfish (*Ictalurus punctatus*). In addition, proximity to the Mississippi River allowed for the relatively cheap transport of grain from the Midwest and Southeast. Traditionally, catfish were harvested in local lakes and rivers by small-scale commercial fishermen.

This industry has emerged from a small, capture-based industry serving local markets to a large aquaculture industry that has expanded to national and international markets. Channel catfish farming is the fastest growing segment of the aquaculture industry in the United States (Lewis and Shelton, undated). Today, there are 196,590 acres of catfish in the United States and 111,500 of those acres are in Mississippi (Dean et al., 2003).

Figure 5.5. U.S.-farmed channel catfish production.



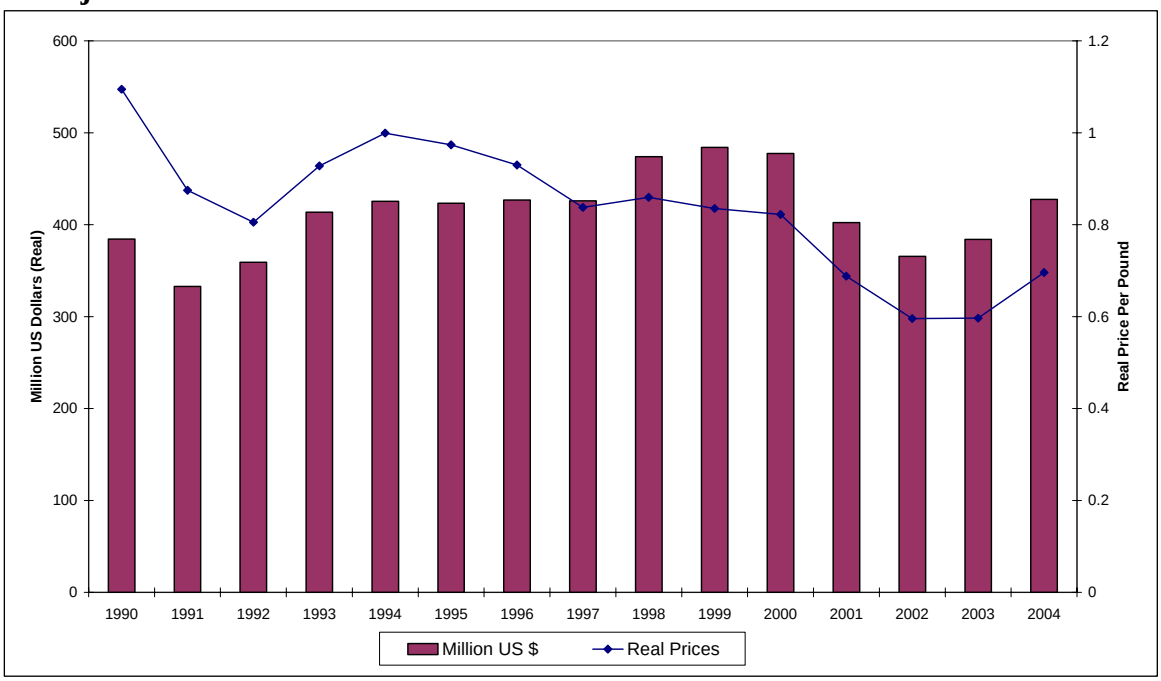
Source: FAO (2005), USDA/NASS (various years)

Catfish production grew from 98,300 metric tons in 1983 to 285,967 metric tons in 2004 (Figure 5.5). Mississippi's farm-raised catfish industry is a world-class example of a commercial aquaculture industry that is profitable, sustainable, and environmentally sound (Dean et al., 2003). Catfish has also gained popularity with consumers, who have increased per-capita consumption of catfish from 0.70 pounds in 1990 to 1.091 pounds in 2004 (NFI, 2005). According to research conducted by H.M. Johnson & Associates for the National Fisheries Institute, domestic consumption of catfish has ranked among the top five in seafood per-capita consumption since 1998.

The gross value of the U.S. catfish industry has averaged $414 million over the past 15 years; however, the value of the industry in real terms in 2003 was essentially identical to the value of the industry in 1990 (Figure 5.6). One factor contributing to this situation has been the declining price per pound farmers have received at the farm gate. In real terms, the price per pound has fallen 36% from its 1990 level. Many factors contributed to the decline in farm-gate prices. Domestically, production levels increased—flooding the market with catfish and thereby driving prices down. During this supply glut, farmers also saw production costs increase, which further shrunk already narrowing profit margins. Feed costs can account for 52-54% of total annual operating costs; therefore, any increase in the cost of feed has a significant impact on overall production costs for each farmer (Engle, 2005). By mid-June of 2005, feed costs had fallen from highs of $310 a ton to $230 a ton for 32% protein feed, and farm-gate prices were on the rise (Coblentz, 2005). The easing of the cost-price squeeze is certain to help farmers in the

short run, as they regain some cash flow to pay debts and possibly increase investment in their operations.

Figure 5.6. Value of U.S. channel catfish aquaculture and farm-gate prices paid to farmers, all adjusted for inflation.



Source: USDA/NASS (various years), FAO (2005)

In an effort to address the impact of foreign competition, trade sanctions were imposed on Vietnam to restrict the labeling of Vietnamese catfish to "tra" *(Pangasius hypophthalmus*) or "basa" (*Pangasius bocourti)* in an attempt to reduce direct competition with U.S.-raised channel catfish (*Ictalurus punctatus*). Concerns still exist regarding foreign competition. Recent revisions in the estimates of catfish imports by the USDA/NASS show that more Vietnamese catfish entered the U.S. market than had been previously thought. Despite the ruling that required Vietnamese catfish be labeled either "tra" or "basa," regulators are finding that catfish fillets are now being imported as frozen fillets of fish, frozen fillets of freshwater fish, and frozen fillets of sole (Bennett, 2003). Previously, the USDA was only reporting Vietnamese catfish imports that fell under the category of frozen fillets of catfish. This revision, then, actually increased the quantity of Vietnamese catfish that entered the U.S. market. In a perverse way, therefore, the new labeling requirement has compromised the ability of regulators to track Vietnamese catfish.

Often, foreign producers have a cost advantage over domestic producers—who are constrained by many factors, including access to credit and environmental regulations. Little can be done to prevent the exportation of technology and expertise to more business-friendly locations, where there is greater access to credit, labor costs are lower, and regulations do not hinder development of the industry.

Key Factors in the Industry's Development

Research and Development

During the 1920s, channel catfish were cultured in hatchery ponds of many state and federal facilities (Hargreaves, 2002). This knowledge, coupled with extensive state and university training for individual farmers helped foster the industry's success. Research scientists affiliated with the U.S. Department of Fish and Wildlife Service's Fish Farming Experiment Station in Stuttgart, Arkansas, and Auburn University provided the technical information, culture guidelines, and technical advice necessary to initiate industry development (Hargreaves, 2002). Federally-supported research conducted at state land-grant institutions throughout the region provided critical technical support and outreach to the industry (Hargreaves, 2002).

Industry Leadership

Significant collaboration took place within the catfish industry, vital to its success. The Catfish Institute and the Catfish Farmers of America are two major associations that formed with the purpose of promoting and protecting the U.S. channel catfish industry. Since its creation in 1986, The Catfish Institute has effectively marketed channel catfish nationally, with Americans doubling their per-capita consumption of U.S. farm-raised catfish since 1986. The Institute has been dedicated to increasing demand for channel catfish by promoting the positive attributes of farm-raised catfish to consumers and food service professionals through advertising and other promotion programs (Hargreaves, 2002). This non-profit corporation derives its revenues from member feed mill dues to fund its national and international marketing campaigns. Established in 1987, feed mill dues were set at $6/ton and, to date, more than $30 million has been invested in The Catfish Institute (Hargreaves, 2002). This joint marketing effort effectively raised public awareness of catfish.

Vertical Integration

This catfish industry has enjoyed some degree of vertical coordination since its inception. The industry developed from agricultural roots and formed cooperatives. In addition, it benefits from a relatively strong trade organization (The Catfish Institute) and it has support from the USDA Extension Service. To a large extent, the industry has avoided the bureaucracy and regulatory complexities that characterize traditional fisheries and coastal aquaculture. Its inland location resulted in the development of high quality fish processing facilities instead of dependency on processing plants used by traditional fisheries.

Catfish processing plants have established contractual arrangements with individual farmers. Approximately 93% of all catfish produced are sold to processing plants (USDA/NASS, 2003), and one arrangement between producers and processing plants requires the farmer to own stock in the processing company. Then, the amount of fish (often in weight) that the farmer can sell to the processing plant is related to the number of shares held. Another arrangement is a "feed for fish" program where plants agree to purchase fish from farmers who purchase feed directly from the company's feed mill (Engle, 2003). Finally, some plants sell delivery rights (frequently $0.15 to $0.20 per pound) that allow the farmer to sell the total weight equivalent of the volume of delivery rights purchased (Tucker et al., 2004).

Expanding Markets

This industry has successfully marketed their product throughout the United States. They have done this by highlighting its many attributes and by providing the product in a variety of value-added forms. The industry has been able to reasonably manage the market, and prices for catfish have remained essentially stable over the past decade (Figure 5.6). Note that a decline in prices (2001-2003) is largely attributed to imports of "tra" and "basa" from Vietnam (USITC, 2003). In addition, production costs have remained relatively stable over that same time period.

Protection from Foreign Competition

During the early 2000s, the U.S. catfish industry experienced significant competition from foreign producers, especially Vietnam. This increase in supply significantly decreased farm-gate prices received by U.S. producers. Through legislative and judicial rulings, the Catfish Farmers of America successfully united against direct competition from Vietnamese catfish producers. In 2002, Congress restricted the use of the word "catfish" to strictly refer to catfish from the *Ictaluridae* family, thereby requiring Vietnamese catfish to instead be labeled "tra" or "basa." More importantly, the Catfish Farmers of America won an anti-dumping suit against Vietnamese producers in 2003, resulting in a country-wide tariff of 64% on Vietnamese "tra" and "basa" imports. As a result, "basa" imports have fallen 50% since the tariffs went into effect in June 2003 (Klinkhardt, 2004). The important lesson to be learned from the catfish industry is that, despite being comprised of many small farms, producers have successfully banded together as a powerful political and industry force.

Lessons for the U.S. Offshore Aquaculture Industry

Reflecting on the two industries presented here, some important lessons emerge that can be applied to the development of a U.S. offshore aquaculture industry. One key similarity between both industries was the presence of strong and well-defined property rights (discussed below). Both industries evolved through increases in economic efficiency, including innovations in institutional structure and markets. Research and development—funded through both public and private investment—increased the technical efficiency of the industry. And finally, the government played a role in fostering or hindering industry development.

Establishment of Well-defined Property Rights

Property rights are a fundamental component of the U.S. agricultural system. The hallmarks of strong property rights include the following: 1) the ability to exclude access and retain net benefits; 2) a high level of security; 3) a long duration; and 4) a high degree of transferability. Within the agricultural sector, property rights allow farmers the legal right to exclude others, thereby limiting the dissipation of rents (benefits) that commonly occurs in unregulated common property resources such as open-access fisheries. The property right is well defined in the sense that, not only does the owner have the legal right to exclude others, but a legal system is in place that supports and enforces this right. The security of the property right is strengthened because there is a system to protect and enforce the property right.

Another important feature of property rights is exclusivity of the right. Exclusivity grants the holder sole control over the property right. Under strong property rights, all decisions and access to the property are controlled by the owner. With well defined property rights,

externalities are internalized and net benefits are captured. Additionally, those that produce externalities that infringe on the property right are held responsible.

Durability is the third feature of well-defined property rights. Durability refers to length of ownership. Typically, strong property rights have a long duration; in some cases, in perpetuity. Short-term property rights are weaker in the sense that they encourage more exploitation of the resource. In this case, owners of the property right have the incentive to behave more myopically, which implicitly raises the discount rate.

The final feature of well-defined property rights is transferability. The ability to sell or transfer the property to another individual is important for two reasons. First, the owner has exclusive control of the property, and with transferability, he or she can transfer the property right with compensation, thereby capturing the value of the property right. A second key feature of transferability is the ability to use the property right as collateral. Since the property right is under the exclusive control of an individual and it has a market value, it is recognized as an asset by lending institutions. The ability to use an agricultural operation as collateral is significant because it allows the owner the ability to acquire financing. This is a critical feature that is not available to aquaculturists in the U.S., whose operations exist on short-term leases that have no market value because they cannot be transferred.

Well-defined property rights are crucial to the development of any industry, because they provide the economic incentives to engage in long-term planning and investment. Producers become more forward looking, invest in new technology, and attempt to gain control of their production and marketing systems. When property rights are insecure, regardless of whether the reason is crime, civil unrest, war, government instability, or government's aggressive use of eminent domain, the resulting dis-incentive is the same. Uncertainty causes owners to be more exploitive with resources, neglecting future costs and long-term investment opportunities in favor of short-term (and most likely, sub-optimal) returns.

In contrast, stronger property rights encourage the owner to make decisions over a longer planning horizon, thereby allocating resources more efficiently and using the resource more sustainably. In essence, strong property rights encourage owners to become strong stewards of the resource. When the government establishes well-defined and strong property rights, sustainability and success are more likely. Thus, for the development of an offshore aquaculture industry, the emphasis should be on creating a business environment where property rights are well defined and enforced. The government should set up and ensure well-defined property rights though the establishment of a transparent and expedient permitting and zoning system, and then allow farmers the ability to operate much like their agricultural counterparts.

Currently, the permitting process is unnecessarily complicated, costly, and time-consuming. Defining the rights and responsibilities of property is an essential first step. Governing institutions need to take responsibility for establishing, protecting and enforcing property rights as a primary responsibility. The emergence of research, investments, and complementary industries will follow, not precede, the establishment of well-defined property rights. Therefore, the focus should be on establishing a process for the creation and

implementation of property rights which will pave the way for the emergence of the following, ancillary factors.

Role of Increased Economic Efficiency

Establishment of well-defined property rights can increase the economic efficiency of an industry. As discussed above, this can manifest in longer operating horizons, better use and management of a resource, and higher levels of investment in capital and technology. Additional forms of economic efficiency can also improve performance of an industry. Within both the poultry and catfish industries, contracts play an important role in diversifying risks, thereby increasing the efficiency and functionality of the markets within both. Contracts allow farmers from both industries some protection from price risks. With this limited protection, a farmer is able to make better investment decisions rather than behave more myopically, due to a perceived level of risk he or she would bear alone.

Consolidation and vertical integration were also key drivers in each industry. Vertical integration allowed producers to reduce risk across the various stages of production by collecting those stages under one company. Vertical integration also allowed companies to better control their chain of production, from chicks or fingerlings to the final fillet, thus meeting the needs of a consumer who demands a consistent, high-quality product in the marketplace. While this may have resulted in fewer and larger companies, it also helped ensure a smoother production process, with a high-quality and higher-valued final product. Significant production risk will reduce the efficiency of the industry, due to an inability or an unwillingness to make appropriate capital investments because of an uncertain business climate. This especially impacts complementary investments in ancillary industries, such as hatcheries and feed production plants.

To date, a critical issue for the U.S. aquaculture industry has been the availability of broodstock from hatcheries. On both coasts, offshore producers have had difficulty acquiring steady, high quality supplies of fingerlings. This problem relates back to a lack of well-defined property rights and the current problems associated with offshore zoning and permitting in the U.S. Persistence of this problem has serious implications for the viability of the industry. The establishment of well-defined property rights will help encourage the development of both the offshore industry and the related ancillary industries, such as processing facilities and feed manufacturers.

Another example of how the U.S. broiler and catfish industries increased the economic efficiency of their industries was through the formation of industry groups that unified their voice and provided strength both in the marketplace and in the courtroom. The aquaculture industry has faced constant opposition from environmental groups, and this opposition has only grown stronger with the emergence of offshore aquaculture as a potential alternative to near-shore or land-based aquaculture operations. The aquaculture industry would benefit from forming a common voice that can counter these criticisms and provides balance to the arguments. A common voice could help the industry gain acceptance from consumers and improve its marketing potential.

Industry collaboration was an important factor in improving the economic performance of both the poultry and catfish industries by improving the markets that each industry faced. In the case of U.S. catfish, the industry formed The Catfish Institute to carry out generic advertising programs and public relation activities to promote catfish consumption (Engle and Quagrainie, 2006). In the case of the U.S. broiler industry, marketing was company-specific, owing to the more consolidated and vertically-integrated nature of the industry. Regardless, each industry was able to essentially grow markets where they previously did not exist.

As the U.S. offshore aquaculture industry develops, direct competition with foreign producers will surely occur and challenge the profit margins of U.S. producers. The majority of aquaculture occurs internationally; therefore, the U.S. is already at a competitive disadvantage, given differences in labor costs and environmental regulations relative to other countries. Furthermore, the current situation regarding the issuance of permits in the U.S. places the industry at further disadvantage, given those additional costs—both in terms of time and money. The U.S. aquaculture sector will have to be innovative in both their production processes and their marketing campaigns if they are to compete with cheaper, well-established foreign producers and still remain economically viable.

Role of Public and Private Sector Research

Research and development of the poultry and catfish industries, both at the public and private level, played a major role in their growth and evolution. Federal, state, local, and university research provided a strong foundation of baseline knowledge for both industries from the outset. Outreach and extension programs then helped disseminate this critical information down to producers at the farm level. With this critical knowledge in hand, the private sector was able to expand and improve production technologies and techniques. In the case of the broiler industry, as production expanded and the industry became more vertically integrated, large-scale private sector research and development emerged. Major companies, such as Tyson Foods, undertook research and development at the company level and provided information to farmers through various programs and arrangements.

In the catfish industry, extension programs played a major role in technological developments. In some cases, initial technologies were developed on farms through partnerships with universities and federal research laboratories, while in other cases the technologies were primarily developed at universities and transferred through extension programs to the private sector (Engle, 2005). In addition to a publicly-financed research program, there has also been some private sector funding of research. For example, Goldquist financed a selective breeding program for channel catfish. However, since the majority of catfish farms are small businesses, they do not have the capital resources necessary to fund private sector investment in research (Engle, 2005).

Applied research, both at the public and private level, will be critical to the success and viability of the U.S. offshore aquaculture industry. While current knowledge exists, further research and development is essential in this ever-changing and evolving industry. Important issues pertaining to disease management, optimal feeding and nutrition, and optimal stocking density will require further research. Both public and private sector investment in research and development will be fundamental to advancing the industry. The presence of well-defined

property rights will provide the correct economic incentives to engage in such behavior. Yet, while technological advancements and economically efficient improvements will be essential in fostering development of an offshore industry, one final key component—the participation of state, local and federal agencies—is critical.

Role of Government

The establishment of land-based operations, whether it is for poultry or catfish, faces significantly fewer obstacles than the establishment of an offshore operation. This relates back to the presence of well-defined property rights in the agriculture sector. For offshore aquaculture, the establishment of zoning and permitting will be critical in the creation of these rights.

As a first step, the government needs to establish a streamlined process for identifying approved areas for offshore aquaculture operations. The zoning process should consider such factors as potential interactions with existing users (commercial, recreations, shipping) and potential interactions with marine life (mammalian interactions and impacts on the surrounding marine environment), as well as bio-geochemical considerations (temperature, nutrients, upwelling, currents, etc.). It is the role of the government to parse out where offshore activity is permitted, leaving the operator free to choose when and how he or she will operate within those zones. Relating back to the U.S. broiler and catfish industries, each was able to operate with minimal restrictions or complications from outside influences. Certainly farmers had to comply with environmental guidelines and requirements (rules regarding waste disposal and groundwater contamination, etcetera) but there was little else constraining their investment and production decisions. Similarly, the government needs to establish where activity is permitted and then allow operators to manage their operations, much like their agricultural counterparts.

Once zoning rules and regulations are established, the actual process of issuing permits to prospective operators must be streamlined. Currently, a number of permits must be obtained for an aquaculture operation—many of which must be obtained in a specific, sequential order. Delay in a given permit can de-rail the entire permitting process, as granted permits expire before other permits are obtained. Additionally, the permitting process is costly—both in terms of the time spent throughout the duration of the permitting process and also in legal fees incurred to fight challenges and denials.

The National Offshore Aquaculture Act of 2007, proposed by NOAA, is designed to streamline the permitting process for offshore aquaculture operations. It is a first step in establishing well-defined property rights for operators, while also addressing the need for regulatory guidelines to address potential environmental impacts and interactions. This Act will be critical to the establishment of an offshore aquaculture sector in the U.S. If current zoning and permitting ambiguities persist, offshore aquaculture will seek out less risky and more business-friendly countries. As it stands, over 80% of the seafood consumed within the U.S. is imported and at least 40% of that is farm-raised (NMFS, 2007, USDA/FAS, 2005). Furthermore, the U.S. seafood trade deficit reached an all-time record of $9.2 billion in 2006, and that number will only grow as the demand for seafood products continues to expand and domestic production remains constant (NMFS, 2007).

Conclusion

To recap, a key component in the establishment of any industry is the establishment of well-defined property rights. Well-defined property rights provide appropriate economic incentives for owners to engage in long-term planning and investments that foster a more efficient use of the resource. In the case of a U.S. offshore aquaculture industry, zoning and permitting issues have hindered industry development. This, in turn, has hindered ancillary developments, such as the ability to secure capital for financing, investment in research and development, and growth and emergence of complementary industries. The development of transportation networks, processing facilities, feed, and hatchery facilities all must occur in a coordinated fashion. The failure of property rights in one industry will affect other industries, given the interdependent nature of aquaculture production. Efforts are already underway to streamline the permitting process with the presentation of the National Offshore Aquaculture Act of 2007 to Congress. The U.S. government has the ability to advance the development of an offshore industry in the United States, and the National Offshore Aquaculture Act of 2007 represents an important first step in this endeavor.

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